HIGHLIGHTS

Restoration of ecological balance in Constitution Gardens Lake:

an example of integrated resource management in an urban park

In 2002, resource managers at National Capital Parks—Central initiated a multifaceted three-year project to restore Constitution Gardens Lake, a 6.75-acre (2.6-ha) artificial water body located in downtown Washington, D.C. The lake provides a setting for some of the nation's most recognizable monuments and is the site of the 56 Signers of the Declaration of Independence Memorial. The lake also provides visitors with an escape from urban stress and is important for urban biodiversity.

Since its completion in 1976, the lake has suffered chronic ecological problems stemming primarily from its design: it is a closed, shallow system with an impermeable bottom that is entirely exposed to direct sunlight and fed by a municipal water source. From the beginning, the system's artificiality promoted an unbalanced ecology characterized by significant algal blooms and rapid sedimentation rates. These problems have been extremely difficult to manage, and costly, short-term fixes have done little to address underlying causes.

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A significant fish kill during summer 2001 prompted park managers to consider long-term solutions and develop a restoration plan that specifically addressed the root of these problems. Natural resource staff believed that restoration should incorporate integrated pest management strategies. Specifically, they determined that success hinged on (1) stabilizing the lake's physical and biogeochemical properties, (2) reestablishing the lake's biotic communities, and (3) developing an action-oriented monitoring program.

To date several major actions have been completed to stabilize the system's ecological dynamics. Specifically, to facilitate more efficient nutrient cycling within the lake, park staff dredged tremendous volumes of nutrient-laden sediments from the lake's bottom. Additionally, they removed nonnative fish species that produce large amounts of waste; this aided in reestablishment of native fish populations in spring 2002. Resource managers have also developed methods to detoxify chloramine from municipal water sources used to fill the lake.

In spring 2003, managers used several physical and biological controls in an attempt to stabilize the lake's oxygen regime and increase nutrient cycling within the system. For example, park staff installed a new circulation and aeration system to reduce stagnation and increase oxygen transfer throughout the water column. Also, staff used microbial additives to stabilize and increase microbial populations. Healthy colonies of bacteria absorb and cycle nutrients, simultaneously reducing nutrient concentrations in the water available for algal growth during the growing season and moderating sediment deposition rates. Finally, park staff constructed large underwater planters and planted native vegetation such as cattails and bull rush. A healthy plant population will help cycle nutrients and produce oxygen during warm weather while also providing cover for young fish. Sustained success hinges on a comprehensive monitoring plan based on preestablished tolerance levels for specified parameters such as nutrient concentrations, pH, and dissolved oxygen that are linked to corresponding corrective actions.

Restoration of the lake will significantly enhance Constitution Gardens as a whole and will be a model for other cities with similar urban water bodies. However, resolution of the problem is complex. Not only do many of the factors involved act synergistically, but management actions tend to receive intense public scrutiny because of the lake's prominent location. Despite these challenges, long-term, cost-effective management of the lake is well within the capabilities of park resource managers.

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Reptiles and amphibians surviving in isolated natural area

Rock Creek Park, approximately 1,754 acres (702 ha), lies within the boundaries of Washington, D.C. Urban growth and development have encroached upon the park since its establishment in 1890 as a natural area. Development and manipulation of the environment have reduced critical reptilian and amphibian habitats to small, isolated areas, and some habitats have disappeared altogether.

Rock Creek Park in partnership with Robin E. Jung of the U.S. Geological Survey (USGS), Patuxent Wildlife Research Center, is conducting an inventory and monitoring study of the reptiles and amphibians in the park as part of the Northeast Amphibian Research and Monitoring Initiative (NE ARMI). The unique location of the park as an island of nature surrounded by residential development has led to its selection as one of the "index sites" for the NE ARMI. Beginning in 2001, NPS and USGS employees intensely surveyed many of the ephemeral pools, streams, springs, and seeps located in the park (figs. 1 and 2). Methods include egg mass counts in the ephemeral pools to document species use and population trends, larval surveys using dip nets at the pools to determine tadpole species and numbers, cover-board surveys using pieces of plywood cut into different sizes to determine species utilization of park areas, and streamside salamander surveys using transects and quadrats to estimate streamside salamander populations. Investigators will analyze this information in relation to a group of environmental and landscape variables and compare the data to other parks and refuges as part of NE ARMI.

While several species historically found in the park have disappeared, investigators have documented 15 salamander and reptile species and rediscovered one salamander species, northern red salamander *(Pseudotriton ruber)* which had not been recorded in the park for 15 years (fig. 3). Through the combined efforts of park staff and Jung, the presence and abundance of the reptiles and amphibians found in Rock Creek Park will be documented. They will also make recommendations to protect and restore habitats for reptiles and amphibians. Because of the baseline inventory data being collected, park staff will be able to develop a monitoring protocol that can be implemented to help protect critical habitats and ensure the survival of these species into the future.

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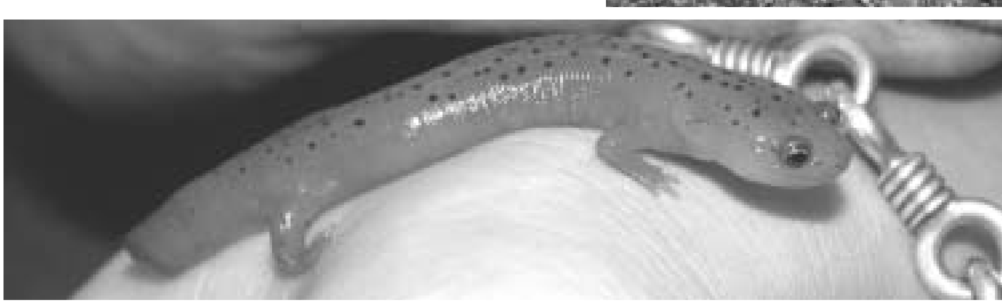
NPS PHOTOS BY KEN FEREBEE

Figures 1 and 2 (above). Ephemeral ponds located in the northern end of the park are critical habitat for egg laying and larval development of salamanders, frogs, and toads.



USGS PHOTO BY PRIYA NANJAPPA

Figure 3. A northern red salamander *(Pseudotriton ruber)*, found in a groundwater seep adjacent to a tributary of Rock Creek, is the first recorded in the park in 15 years.

Vegetation Inventory and Monitoring Program revisited at

Shenandoah National Park

The National Park Service is committed to inventorying and monitoring the natural resources under its stewardship. Effectively meeting this commitment is a complex challenge. The Long-Term Ecological Monitoring System at Shenandoah National Park, Virginia, has been in operation for more than a decade. However, in 1999 the natural resources staff decided it was time to reassess both the objectives and the design of their vegetation inventorying and monitoring programs.

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Staff needed to address fundamental questions about how to determine which data are statistically relevant. How much change in the canopy composition, for example, is important to detect? How much change is significant? The original program objectives were very broad. Staff wanted to clearly define what level of change sampling should detect and then design a protocol that would provide that information.

Technicians sample herbaceous vegetation within a newly installed (upgraded) forest long-term monitoring plot in Shenandoah National Park.

In March 2000 staff at Shenandoah National Park hosted a one-day workshop for the purpose of developing statistically precise objectives for the Vegetation Mapping Program. There were 17 participants including park staff, and scientists from Virginia Tech, Virginia Department of Forestry, Virginia Natural Heritage Program, Penn State, the Nature Conservancy, the U.S. Geological Survey, and the USDA Forest Service. Participants broke up into three working groups, each focusing on an area of interest previously identified by resource managers at the park.

The group focusing on general forest trends recognized the need to follow changes in vegetation composition and distribution. From this need the group developed three management objectives. One of these, for example, was to detect a 50% change in density of any one species of tree (dominant or codominant) within any one forest cover type over a five-year period. The related sampling objective required 90% assurance of such detection, accepting a two-in-ten chance that a change may be inferred when it really did not occur.

Another group focused on forest health. This working group addressed threats to the forest, such as air pollution, invasive exotics, white-tailed deer, and visitor trampling. The group recommended the management objective: to see a 20% decrease in the acreage of a specific exotic plant species parkwide from 2002 to 2005. The sampling objective required 80% assurance of detecting a 20% change in coverage of an exotic species over those years with a two-in-ten chance that a change may be inferred that did not occur.

The third group, focusing on special and unique ecosystems and species, identified several community types and species that are extremely rare at the park. For each of these, the group developed management and sampling objectives similar to those from the other working groups.

Having defined objectives at the workshop, the next step was to evaluate the current sampling process at Shenandoah and determine whether it could meet the objectives. Duane Diefenbach, USGS Biological Resources Division Cooperative Research Unit at Penn State, performed this statistical analysis. His results indicated that few of the newly defined program objectives could be met with existing data under the current sampling design. He recommended modifying factors such as the timing of sampling, the choice of strata for randomizing, and sample size. Diefenbach worked with natural resources staff at the park during the summer of 2002 to develop a sampling design that can meet or reevaluate the objectives, as needed.

This project is a work in progress. In summer 2003 staff began sampling according to the new design, and several more years will pass before managers at Shenandoah National Park can evaluate its success.

Information about the Vegetation Mapping Program at Shenandoah is available from Wendy Cass at 540-999-3432 or wendy_cass@nps.gov. The technical report of the workshop and statistical evaluation is available at <www.nps.gov/phso/science/FINAL/SHEN_sampling_design.htm>.

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Present landscape reflects historic appearance in Washita Battlefield National Historic Site

Washita Battlefield National Historic Site in Oklahoma may be in an enviable position. Park staff and volunteers have nearly eliminated tamarisk from the site. The Natural Resource Challenge through an Exotic Plant Management Team (EPMT) enabled this accomplishment. There are some caveats, however: tamarisk remains along an ephemeral tributary of the Washita River, and a major effort will have to be maintained to combat new sprouts and diminish upstream seed sources. Nevertheless, all standing tamarisk along the 1.25 miles of the Washita River that flows through the park has been cut down. The Chihuahuan Desert–Shortgrass Prairie EPMT (based in Carlsbad Caverns National Park) is anticipated to return to Washita Battlefield at least two more times over the winter-spring of 2003–2004. These trips will focus on cutting and treating the remaining tamarisk lining the tributary, and revisiting previously treated areas where tamarisk saplings have resprouted.

Park managers understand that Washita Battlefield National Historic Site does not represent ecosystem-level processes. Furthermore, eliminating tamarisk (or any other exotic) from within its boundaries has little effect on the untold acres of nonnative plants present on the agricultural lands of the surrounding Great Plains. Yet Washita Battlefield is a cultural (and natural) landscape, sacred to the Cheyenne, Arapaho, and other tribes affiliated with the site. The enabling legislation of the historic site requires the National Park Service to return the battlefield as closely as possible to its appearance in 1868, the year of the battle. For all the visitors who come to the site trying to imagine the altercation between the U.S. Cavalry and the Plains Indians 135 years ago, it is important that the landscape reflect its historic appearance. By removing a visually intrusive, nonnative tree from along the length of the Washita River, the National Park Service has honored its enabling legislation and improved the experience of visitors.

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Water quality analysis of Fort Pulaski National Monument

Fort Pulaski National Monument is located in coastal Georgia along the Savannah River, approximately one mile from its junction with the Atlantic Ocean. Two islands, which before human intervention were primarily salt marshes, comprise the 5,200-acre (2,100-ha) site. The monument protects some of the most pristine resources in the area, such as Class 1 waters that are used for recreational harvest of shellfish. However, these waters are potentially threatened. Contamination from industrial sources upstream in the vicinity of metropolitan Savannah includes wastewater treatment pollutants, chemical producers, a natural gas processing facility, and a paper mill. In addition a nuclear weapons production facility is farther upstream. The Savannah River Site is notorious for contamination of the Savannah River and its tributaries, for example, during a tritium spill in 1991.

Industrial development in the Savannah area has, in turn, fueled development of port facilities. Commercial ship traffic requires substantial dredging in the main channel of the Savannah River to sustain the ever increasing depth requirements. During the dredging process contaminants sequestered in the sediments are suspended in the water column, threatening the monument and surrounding areas with reintroduction of contaminants. A proposal by the U.S. Army Corps of Engineers and the Georgia Ports Authority to increase the dredged depth of the shipping channel in the Savannah River to 50 feet mean low water (MLW) from the current depth of 42 feet MLW threatens to exacerbate the problem.

In 2001 and 2002 the park received Natural Resource Preservation Program funding for small parks and contracted with Savannah State University to conduct a water quality analysis of the 4,800-acre (1,940-ha) salt marsh estuary within the monument. The goal of this research was to acquire baseline chemical data necessary to evaluate the ecological health of water resources at the monument. Investigators designed the project to evaluate the levels of chemical pollutants, including heavy metals and organic compounds, in marsh-estuarine sediments and oyster tissues. The study used sediment, oyster, and water samples acquired from nine locations within the monument's boundary. Investigators focused data analysis and interpretation on problems that would be of immediate concern to park management.

The results of the study indicated that chemical contamination has caused no significant impact of waters within the monument. Of utmost significance, however, is that park managers now have substantial baseline data regarding the health and condition of the salt marsh estuarine environment. Scientific information now exists to adequately evaluate changes over time in the ecological health and water resources of Fort Pulaski National Monument.

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Volunteers help restore disturbed lands in Grand Canyon National Park

Visitors may see cliffrose, Indian paintbrush, stemless townsendia, early flowering wood-betony, and varieties of cacti and penstemon in the ponderosa pine or piñon-juniper woodlands on the South Rim of the Grand Canyon. They may also notice Dalmatian toadflax, cheatgrass, spotted knapweed, Mediterranean sage, and rush skeletonweed. While these latter plants may contribute to the colors of the landscape, they are some of the 160 plant species not native to Grand Canyon National Park.

NPS PHOTO BY MIKE BOOTH

Dedicated volunteers in the park have helped to restore disturbed lands by donating more than 16,500 hours to the vegetation management program in 2002. They rehabilitated more than 24 acres (10 ha) of disturbed lands while they gained hands-on experience removing exotic species, planting native species, collecting seed, and spreading mulch. Even a few hours of manually digging Mediterranean sage with hand picks contributes to the overall preservation of park resources. Many groups and organizations such as Elderhostel and Sierra Club return annually to satisfy their vested interest in the restoration projects in which they participate. Volunteers take pride in their work and many remember the specific plants they have planted.

Partnerships' and volunteers' long-term commitment to restoration efforts greatly benefit Grand Canyon National Park. Volunteers help the National Park Service achieve its mission and goals. Some volunteers return to their homes and seek out local natural areas in which they can volunteer. They may even carry a sense of stewardship into their own backyards.

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